

**3GPP TSG RAN Meeting #102**

**RP-233052**

**Edinburgh, Scotland, December 11th – 15th, 2023**

**Agenda Item: 9.1.1.5**

**Source: vivo**

**Title: Rel-19 Network energy saving enhancements (RAN1-led)**

**Document for: Discussion**

## Outcome from RAN#101 meeting

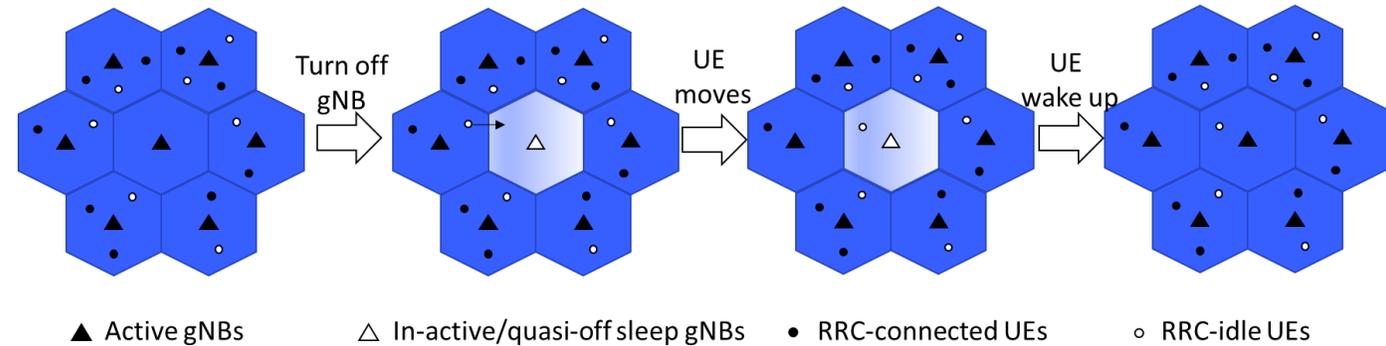
- References: [RWS-230488](#), [RP-231540](#), [RP-232615](#)
- Potential objectives:
  - On-demand SSB transmission ~~(and possibly other DL signals)~~ for Scell for connected UEs
    - Possible triggering methods (e.g., UE uplink wake-up-signal [using an existing signal/channel](#), cell on/off indication via backhaul, Scell activation/deactivation signaling, etc.)
    - ~~Whether to target the design of a simplified SSB~~
  - On-demand SIB1 ~~[SSB]~~ transmission for idle UEs
    - Possible triggering methods (e.g., UE uplink wake-up-signal [using an existing signal/channel](#), cell on/off indication via backhaul, Scell activation/deactivation signaling, etc.)
    - ~~Whether to target the design of a simplified SSB~~
  - Other topics?
- [SSB]/SIB1-less operation in multi-carrier scenario for (documented in TR38.864)
  - [SSB]/SIB1-less for non-anchor NES cell for UEs in IDLE/INACTIVE state, where it is assumed that another carrier (an anchor cell) is available for the UE
- Adaptation of common signal/channel transmissions (documented in TR38.864)
- Specify Cell DRX/DTX for UEs in idle/inactive modes (as an extension of Rel-18 cell DRX/DTX)
- Multi-TRP adaptation mechanisms
- UE group-common or cell-specific BWP configuration, adaptation and/or switching.
- Group cell switch
- Power domains studied in R18 (techniques D-2 ~ D-5)
- Low-power SSB/SIB1/Paging
- Extension of spatial and power domain techniques in 1) high load scenarios 2) Type-II codebook types
- Semi-static beam-specific broadcast channel configuration
- Scenario 2a for SSB-less
- It was also mentioned that some proposals for multi-carrier enhancements may be beneficial for network energy savings (e.g. cross-carrier HARQ, fast DL carrier switch, multi-carrier CSI)
- Extensions to network-controlled repeaters (NCR), e.g. backhaul/control link behavior for efficient interaction between NES-capable gNB and associated NCR, to consider the case where the gNB would operate with S/P-domain adaptation or cell DTX/DRX adaptation for NW energy saving

- Background: In Rel-18, SSB-less Scell is specified for inter-band CA case where the Scell can perform sync, QCL and etc. based on SSB in a reference cell when meeting certain requirement (e.g. co-located, same TAG, timing requirement and etc.)
- Motivation: Enable a Scell to reduce SSB transmission when no reference cell can be find for the Scell
- Details: When there is need to perform time/frequency synchronization, L1/L3 measurement and procedures related to Scell activation, SSB transmission is triggered on the Scell.
  - After Scell activation, SSB transmission should return to normal periodical transmission. Otherwise, it may introduce large impact to UE' s normal operation (e.g. measurement, QCL source and etc.)
- **Suggested objective description:**
  - Specify procedures and signaling method(s) to support on-demand SSB SCell operation for UEs in connected mode with inter-band CA. [RAN1/2/3/4]
    - Note: on-demand SSB transmission is used by UE before Scell activation for SCell time/frequency synchronization, L1/L3 measurements and SCell activation, and is supported for FR1 and FR2.

- Background: On-demand SSB/SIB1 by UE WUS is that is proved and concluded beneficial in Rel-18 SI phase but not specified in Rel-18 WI phase
- Motivation: Enable a Pcell to reduce SIB1 transmission and SSB transmission where this Pcell can be camped by idle/inactive UEs

- Details:

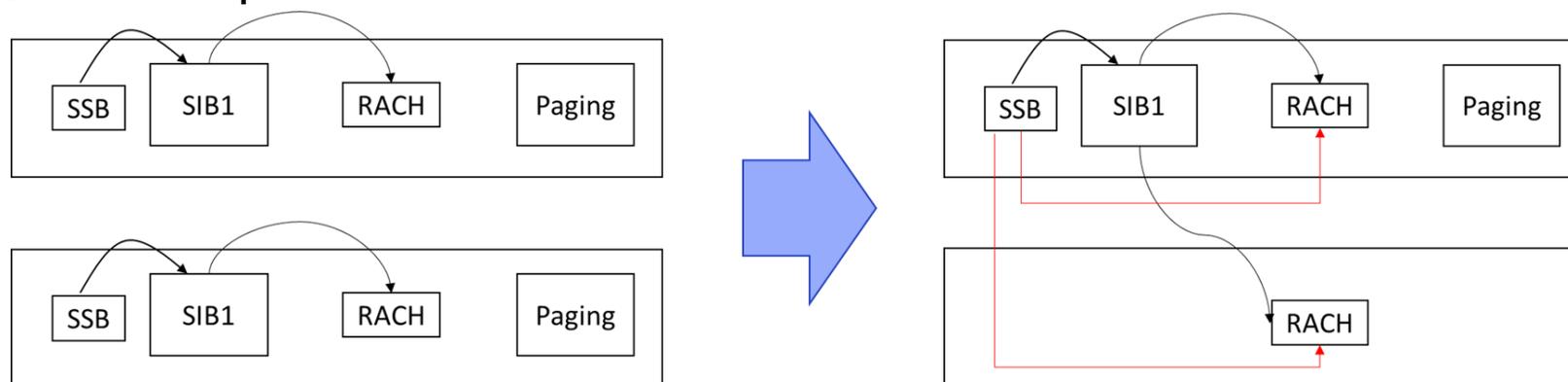
- A gNB is entering NES mode without SIB1 and sparse SSB while monitoring UE WUS
- An idle/inactive UE that moves to the NES cell may trigger WUS transmission
- The gNB recovers to send SIB1 and normal SSB for the UE to camp



- **Suggested objective description:**

- Specify procedures and signaling method(s) to support on-demand SIB1 for UEs in idle/inactive mode. [RAN1/2/3]
  - Note: SSB and RACH adaptation can be performed by UE WUS.

- Background: SIB-less cell operation is beneficial for network energy saving based on SI outcome
- Motivation: further reduce common message overhead without impacting RACH capacity
- Detail: UE obtains system information for anchor carrier and necessary system information for non-anchor SIB-less carriers in anchor carrier only. Then a UE may perform random access/data transmission/data reception in one or more of anchor carrier or non-anchor carriers.



- **Suggested objective description:**

- Specify support for SIB1-less operation for non-anchor NES cell for UEs in idle mode. [RAN2/1/3]
  - UE can access from SIB1-less non-anchor NES cell, for which the SIB1 is carried on an anchor cell.
  - Paging is transmitted on an anchor cell.

- Background: Adaptation of common signal/channels is beneficial for network energy saving based on SI outcome. Static adaptation of SSB/RACH can be done by SIB1 update.
- Motivation: Perform fast adaptation of SSB/RACH depending on needs, that leads to NES gain.
- Detail:
  - Fast SSB adaptation: SSB period and the number of SSBs within a period can be adapted based on gNB/UE need
  - Fast RACH adaptation: RACH period and number of ROs within a period can be adapted based on gNB/UE need
- **Suggested objective description:**
  - Adaptation of common signal/channel transmissions. [RAN1/2/3/4]
    - Fast adaptation of time-domain SSB patterns including adapting time-domain positions (periodicity and time resource locations within a period) and the number of SSBs within a period.
    - Fast adaptation of PRACH
    - Note: Adaptation of SSB and PRACH can be combined with Objective 2.

- Objectives:
  - Specify procedures and signaling method(s) to support on-demand SSB SCell operation for UEs in connected mode with inter-band CA. [RAN1/2/3/4]
    - Note: on-demand SSB transmission is used by UE before SCell activation for SCell time/frequency synchronization, L1/L3 measurements and SCell activation, and is supported for FR1 and FR2.
  - Specify procedures and signaling method(s) to support on-demand SIB1 for UEs in idle/inactive mode. [RAN1/2/3]
    - Note: SSB and RACH adaptation can be performed.
  - Specify support for SIB1-less operation for non-anchor NES cell for UEs in idle mode. [RAN2/1/3]
    - UE can access from SIB1-less non-anchor NES cell, for which the SIB1 is carried on an anchor cell.
    - Paging is transmitted on an anchor cell.
  - Adaptation of common signal/channel transmissions. [RAN1/2/3/4]
    - Fast adaptation of time-domain SSB patterns including adapting time-domain positions (periodicity and time resource locations within a period) and the number of SSBs within a period.
    - Fast adaptation of PRACH
    - Note: Adaptation of SSB and PRACH can be combined with Objective 2.
- TU: RAN1 (leading group): 2 TU, RAN2: 1 TU, RAN3: 0.5 TU, RAN4: 0.5 TU

THANK YOU.

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